Shades of Green:

Using Computer-Aided Qualitative Data Analysis to Explore Different Aspects of Corporate Environmental Performance

Claudia Poser[1]

Edeltraud Guenther[1]

Marc Orlitzky[2]

[1] Faculty of Business and Economics, Chair of Environmental Management and Accounting, Technische Universität Dresden, Germany

[2] The Pennsylvania State University Altoona, USA

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Abstract

This paper provides a comprehensive overview and synthesis of the various definitions of corporate environmental performance (CEP) in conceptual and empirical papers. Based on an overview of existing conceptual and empirical studies of CEP, we analyze the complex nature of this multidimensional construct. In a first step, we apply content analysis to the relevant literature to identify definitions of CEP and conduct a bibliometric analysis using the software HistCite. We found only few studies that provide a clear definition of CEP. In a second step, we use a semantic mapping methodology by applying Leximancer, a computer-aided qualitative data analysis tool to organize the large literature on CEP and to explore the definitional and conceptual complexity of CEP. To our knowledge, this is a new and unique approach in the field of environmental management. This paper contributes to research on CEP in three ways. First, it collects and summarizes definitions and measurements of CEP used in the organizational literature so far. Second, it provides a bird's eye view on the different contexts in which CEP is discussed. Third, a parsimonious model of CEP derived from computer-aided qualitative data analysis and consisting of five major elements is presented and discussed.

Keywords: computer-aided qualitative data analysis software (CAQDAS), content analysis, corporate environmental performance, HistCite, Leximancer.

1. Introduction

The construct of corporate environmental performance (CEP) has been widely used and discussed in numerous international and regional standards (e.g., ISO 14031 or the Global Reporting Initiative guidelines), scientific publications, and company reports. Moreover, the term *environmental performance* is used in varying contexts with different objectives and meanings. For example, in Rahman and Post's (2011) review of different definitions of environmental corporate social responsibility, the authors suggest that the concept is multidimensional, and CEP one of its dimensions. In this article, CEP is represented by disclosing information about the use of energy and water as well as greenhouse gas emissions and toxic releases and spills. Furthermore, they critique the lacking transparency, reliability, and validity of the existing measurements. Nevertheless, there is still no consensus and no conclusive understanding of the multidimensional concept of CEP. Instead, there is a diverse set of approaches and perspectives discussing CEP and its dimensions. Scholars from various subdisciplines draw on different theories and paradigms to answer their particular research questions (strategic attributes or resources, stakeholder perspectives, firm-level attributes like size or information flows, etc.). However, this wide range of approaches makes it difficult to synthesize the findings. As Etzion (2007: 638) states, “A clear and uncontested definition of what is actually included and excluded from the definition of corporate responsibility toward the environment is lacking.” Moreover, most of the research concerning CEP is empirical, which is surprising as one would expect that new research fields grow first by development of theory followed by theory testing (Bansal & Gao 2006: 468). Hence, there is no common theoretical basis from which measures for empirical studies are derived.

The goal of our paper is to provide a comprehensive overview of the different definitions and measures of environmental performance. Therefore, we collect literature investigating CEP and extract definitions of CEP. Furthermore, we analyze the content of the

textual documents describing CEP, visually display the extracted terms using qualitative content analysis, and discuss the implications for research on CEP. Because the existing conceptual and empirical literature is fragmented we intend to derive a synthesized definition of CEP. In pursuit of this goal, our paper is structured as follows: First, we review current methodological approaches concerning CEP and present content analysis as the research methodology of our choice and the selection process for the literature included in the analysis. Then, we conduct a qualitative content analysis of the selected articles to map definitions and measurements of CEP used in literature. Furthermore we perform a bibliometric analysis using HistCite to analyze the interconnectedness of the research. Finally, we use Leximancer, a software tool that performs a computer-aided content analysis and, thus, goes beyond a simple keyword search (Smith & Humphreys 2006: 262). This approach broadens our view on CEP and can shed light on the complexity of the term CEP. We conclude the paper by integrating the revealed aspects of CEP both, into a parsimonious and a comprehensive model.

There have already been several attempts to establish a better understanding of CEP. Bansal & Gao (2006) illustrate two main perspectives in research of organizations and the natural environment: organization theory and performance as well as environmental outcomes. They argue that these are two very different approaches and find that most research is focused on environmental outcomes. They also point out that only few articles are published in general management journals. Etzion (2007) reviews the literature on organizations and the natural environment on three levels: firm, industry, and organizational environment. He concludes that “the issue of organizations and the environment is broad and multilayered and has not been exhausted” (Etzion 2007: 638). Furthermore, Berchicci and King (2007) conduct a review on the business and environment literature. They argue that “the word environment refers to everything from the health of the community to the

appearance of a neighbor's yard" (Berchicci and King 2007: 513). This understanding may be explained by its connection to the economic concept of externalities. They postulate that the effects from economic activities can be separated into internalities (business) and externalities (environment) which creates the research field often labeled *business and the natural environment*. Hoffman (2011a, 2011b, 2011c) discusses the boundaries and historical trajectory of research on business and the natural environment and provides a list of the most influential articles in this area.

Although these reviews provide useful insights into the research field of organizations and the natural environment, they did not elaborate on the full conceptual dimensionality. They did not aim to identify the different definitions of CEP in the context of bibliometric and content analyses. Therefore, we concentrate our analysis of CEP measurement by extracting definitions from the literature and conducting an automatic content analysis with the software Leximancer. This research strategy circumvents the subjectivity of traditional content analysis and helps "to avoid fixation on particular anecdotal evidence" (Smith & Humphreys 2006: 262).

2. Research methodology

In our analysis we intend to extract definitions of CEP from the extant literature in order to shed light on the concept of CEP because an uncontested definition is still lacking. We review relevant studies of CEP systematically by applying content analysis. "A literature review is a systematic, explicit, comprehensive and reproducible method for identifying, evaluating, and interpreting the existing body of original work produced by researchers and scholars'' (Fink, 2010, p. 44). However, reviews can be biased and lack rigor or thoroughness (Tranfield, Denyer & Smart 2003). The method applied in our paper consisted of three steps. First, we selected the relevant literature which is a key element in developing the evidence base. (Tranfield, Denyer & Smart 2003) Second, we gathered definitions of CEP from

literature review and divided them into explicit and implicit definitions. Third, we used the computer-aided qualitative data analysis software Leximancer to conduct an automated content analysis of the text of the articles.

Selection of journal articles

In a first step, we collected the relevant studies of CEP. We identified a considerable body of work in the environmental performance literature. Searching for the term *environmental performance* in the title, keywords, and abstracts in scientific databases (see below for more details) yielded more than 3,700 results. The selection of the relevant literature initially was not easy because of the heterogeneous use of terms concerning environmental performance. Therefore, it was important to define clear boundaries for our analysis. Our method focuses on a systematic and explicit selection of the relevant studies and was intended to be as simple and straightforward as possible considering the observed heterogeneity (see also David and Han 2004). We did so by choosing the following inclusion and exclusion criteria.

Our search was limited to scientific English-speaking journals. At the same time, our selection of the articles was not limited by journal. We searched for the keyword *environmental performance* in the title, abstract, and author-supplied keywords as well as in the text itself in the following databases: *Elsevier (Sciverse), Emerald, Springer, Wiley*, and the library service *Ebsco Host*. Cited references were used as secondary sources of literature, also known as ancestry searching or citation chasing (Aguinis et al. 2011: 9), but this search technique did not produce many additional papers. Because the research field on environmental performance is so heterogeneous, we identified a large body of application-oriented research in which environmental performance is used as a term, but is not the main research subject in those studies. We included empirical as well as conceptual studies in our analysis. By applying these criteria, we collected 165 studies in total. Of these 165 studies, 80

empirically investigated the relationship between CEP and corporate financial performance (CFP). Another 85 studies concentrated on the natural environment—primarily as a dependent variable. We divide the latter category of studies into two clusters: 41 empirical and 44 conceptual papers. Empirical papers are studies which concentrate mainly on the investigation of empirical relationships regarding different dimensions of CEP with variables like environmental management systems, environmental strategies, or environmental disclosures. In contrast, conceptual studies focus on the development of theoretical knowledge, for example, creating environmental performance indicators. For example, we identified many studies by searching for environmental performance in the title, abstract, and/or keywords of the literature. In many cases, we also noticed that environmental performance was only used as a control variable or was treated as a tangential issue. However, in our research question we focus on environmental performance and its different dimensions, that is, environmental performance must not be a minor or reduced concept in the study. As we focused on papers, that deal with the different perspectives of CEP only, papers analyzing the relationship of CEP to other phenomena of business research, such as tourism industries, marketing outcome, or antecedents of environmental performance like stakeholder salience as well as studies that do not focus on the organizational level of analysis (e. g., innovation studies, competitiveness studies) were excluded. However, we want to consider the important stream in literature that investigates the relationship between CEP and corporate financial performance (CFP). Although most of these studies do not discuss CEP in detail, they often draw on specific measures of CEP used previous studies. By searching for studies dealing with this relationship, we were able to identify 465 empirical studies on this linkage. In order to generate a broad view on the topic of CEP, we also analyzed these studies. From this set of 465 studies, we selected only those that directly refer to CEP, apply the term “environmental performance,” and provide a definition or a verbal description of its measurement. This criterion is important because we find a large body of literature referring not explicitly to

CEP, but instead using other terms like social performance, corporate social responsibility, or sustainability performance. Studies that focus on the relationship between CEP and CFP belong to a special research stream. Therefore, we use these studies only for extracting definitions and measures of CEP. We exclude these studies from further bibliometric and computer-aided content analysis due the different scope of research.

According to our analysis, a common approach in measuring and operationalizing CEP is to develop a set of environmental indicators and then aggregate them, for example, into a balanced scorecard or an environmental report. Several organizations have taken the initiative in standardizing CEP measurement. This results in a large amount of standardization schemes. The most important sources are: the reporting guidelines of the Global Reporting Initiative (2001), the Eco Management and Audit Scheme (EMAS) from the European Environment Agency (2009), the ISO 14031 (environmental performance evaluation), and the Association of Chartered Certified Accountants (ACCA) report on environment-related performance measurement. Each approach uses several criteria for CEP measurement and each one has its own unique strengths and weaknesses. However, these approaches refer to the environmental performance evaluation which must not be confused with a basic conceptual approach towards CEP. Consequently, in our study we focused only on the academic literature that examined the concept of CEP from a theoretical perspective or empirically studied CEP as its main focus. Apart from the literature that focuses on CEP and its dimensions only, there is a variety of research streams including CEP as one variable of many.

Finally we include 80[1] studies on the relationship between CEP and CFP in addition to our 85 empirical and conceptual studies. In the following section, we describe the next steps

[1] We identified 465 studies (see Guenther E, Hoppe H, Endrikat J 2011) on the relationship OEP-CFP (financial performance).From this sample we excluded studies that focused on social performance, sustainability, social responsible investments, etc. yielding a final sample of 80 studies in this study.

of our methodological approach. First, we conducted a bibliometric analysis of the 85 papers focusing on the environmental research (not CEP-CFP studies). Second, we extracted definitions and verbal descriptions of CEP from the whole sample of 165 studies. Third, to broaden our view on the concept of CEP we use computer-aided qualitative data analysis software (CAQDAS).

3. Bibliometric Analysis: distribution across time periods, main journals and citation analysis

The selected literature consists of 85 papers, which were published in 40 different journals. The first year of publication is 1980. Interestingly, no pattern can be seen from the journal and time analyses: we find a constant rate of publication over time with two peaks in 2001 and 2004. Both cannot be attributed to special issues on the concept of CEP. Table 1 shows the spread of research articles over the period covered in our analysis. The scattered structure of the matrix is apparent. The largest number of articles was published in *Business Strategy and the Environment* (9 papers), *Journal of Cleaner Production* (8), *Environmental Quality Management* (6), *Greener Management International* (5), *and Eco-Management and Auditing* (4). The matrix also shows a predominance of journals with a specialized environmental orientation (15). Another group of journals (7) is of a technical nature or have a practitioner's background like Construction Management and Economics for building and civil engineering. Furthermore, we also identified mainstream premier management (6) and accounting journals (6), such as *Academy of Management Journal* or *Accounting, Organizations and Society*. Finally, there are two minor groups of journals from the operations (2) and policy (4) literature. Based on the distribution of the articles, it is clear that CEP is discussed in many contexts and from many different perspectives.

(Insert Table 1 about here.)

In addition, we conducted a citation analysis with Histcite software to visualize the history of research on CEP. Histcite produces historiographs which display a time-based network diagram of the papers and their citation relationships to each other. The historiographs for our papers can be found in Appendix 1 as well as the timeline with cited references and the list of all records (Appendix 2). In our historiograph, each paper is represented by a number (numbering can be derived from the record list). We find that recent studies increasingly refer to prior literature. However, it is important to notice that mostly empirical studies cite prior empirical literature in order to justify their applied measures/operationalizations of CEP. We do not find many citations across both clusters of studies. This can be concluded from Appendix 2 (and Tables 3 and 5, which will be discussed later). For example, Thoresen (1999), Young (1998), Johnston (2001), and Gerde (2005) are conceptual studies that cite mostly other conceptual studies (such as Ingram 1980, James 1994, Lober 1996, or Azzone 2000). This reveals that theoretical and empirical investigations of CEP are rather distinct issues and empirical measures may not be based on theoretical conceptualization of CEP.

In summary, the literature on CEP is rather fragmented regarding its journal publications. Studies on CEP often do not relate to the existing body of literature. In particular, a connection between conceptual and empirical research is lacking.

4. Gathering CEP definitions

In our next step, we examined the types of definitions that can be found in our literature sample. Therefore, we searched through our selected papers for the term “defin*” and checked whether this term occurred in relation to environmental performance. In Table 2, we list the explicit definitions of CEP found in the literature. We call this “explicit definition” when the authors provided a clear definition of CEP using the term “define” in their

explanations on CEP. We were surprised to find that only a minority of papers (14 out of 165 studies) provided a clear and explicit definition in reference to CEP.

(Insert Table 2 about here.)

Three of those definitions refer directly to the definition of ISO 14031. Judge (1998) goes beyond that definition and includes meeting the expectations of stakeholders. He refers to compliance with regulations and emphasizes that it is not mere compliance but must have a proactive stance. Ienciu (2009) describes CEP as the vector of harmful environmental impacts caused by firm activities and Clemens (2010) defines CEP as multidimensional construct.
There are only a few explicit definitions of CEP; those explain it mostly by measurable results of the management of environmental aspects. Only one author extends that definition by expectations of stakeholders. Finding only these five definitions is not satisfactory, if we consider the large amount of research, especially empirical work, using the term *environmental performance*.

Therefore, we searched for other forms of description of CEP revealing implicit definitions. In Table 3, we list all other forms of verbal descriptions of CEP that we found in the papers. However, sometimes these formulations already refer to a specific operationalization of the construct of CEP. This is evident as these formulations list several items in a row regarding CEP. This suggests that researchers often fail to distinguish between conceptual and operational definitions and are, therefore, prone to use a research strategy of operationism, which specifies scientific terms only in relation to a set of physical measures (see also Cohen 1989: 147-162). Sometimes, researchers in this area seem to forget that specific indicators only represent one dimension (of many other possible dimensions) of a concept. This conceptual ambiguity is typically reflected in research questionnaires as well. For example, our review indicates that survey studies often ask the respondents questions about the focal company's environmental performance (e.g., improvements or changes in

CEP) without clearly stating first what the researchers actually meant by environmental performance (e.g., Iraldo 2009). In Table 3, we list the verbal descriptions found in conceptual CEP papers, and Table 4 contains the measurement descriptions of CEP in empirical studies and CEP-CFP studies.

(Insert Table 3 about here.)

Because these implicit definitions describe specific applications of CEP and propose particular indicators of CEP, the contents are elusive.

The majority of studies used measures based on wastewater productions, water and air emissions, data from the US Toxic Release Inventory (TRI), compliance with regulatory requirements as well as measures on waste generation and disposal. However, we find a very fragmented structure of the applied measures. Items like complaints, environmental research and development, environmental marketing activities, and integration of environmental issues into administrative work are only mentioned once in a study. We further observe that there is also a large variety in the absolute number of measures applied in each study. Henri (2008) uses by far the most indicators of CEP (17), followed by Souitaris (1998) (8) and Yin (2009) (8). The majority of studies apply only one or two different measures for CEP. If we focus on these studies that rely only on one or two measures of CEP, we find that they apply mostly those measures already indicated to be the dominating ones like emissions and TRI data. Table 4 supports a view of CEP as a complex heterogeneously structured construct in the literature. The proposed measurement items for CEP are elusive.

(Insert Table 4 about here.)

We find evidence for a research strategy of operationism, meaning that instead of explicitly defining scientific terms, scholars only implicitly define them in relation to a set of physical measures. Hence, the conceptual essence of the term remains elusive.

In light of these debates and complex results, we want to further explore the mosaic of CEP literature using computer-aided qualitative data analysis software (CAQDAS). Such software allows for the analysis of the semantic and contextual structure of selected articles. More specifically, "Leximancer has been used for qualitative data analysis in academic research settings in business and the public sector, in social and cultural studies, and in research on education" (Crofts 2010: 188). Hence, we want to gain a broader view on the concept of CEP by analyzing the whole contexts in which CEP is discussed. In the next step, we conduct the computer-aided qualitative data analysis for our 85 conceptual and empirical studies on CEP. We exclude studies on the relationship between CEP and CFP because these studies focus merely on a financial perspective. However, we want to explore the research fields on CEP in narrow sense.

5. Computer-aided qualitative data analysis software

The previously postulated heterogeneity raises the question whether all the different environmental indicators really form a meaningful, overarching concept of CEP. Arguably, computer-aided text analysis and content analysis mitigates the problems of qualitative analysis (Vaivio 2008). Crofts (2010) derived the following advantages of CAQDAS: enhancement of systematization, logic, transparency, speed and rigor, engagement with research question and reduction of enormity of data. We selected the Leximancer software tool to conduct such a qualitative, follow-up text analysis. Leximancer is a text-analysis tool which "can be used to analyze the content of collections of textual documents and to display the extracted information visually" (Leximancer Pty Ltd. 2010: 4). One of the key capabilities of Leximancer relate explicitly to our research goals as it searches for context models in the meaning of texts (Crofts 2010: 187). Furthermore, in content analysis, the presence of words and concepts in textual documents are determined. This information is broken down "into manageable categories and relationships in order to quantify and analyze the text"

(Leximancer 2010). Leximancer automatically extracts information from a set of documents and forms it into themes[2] and concepts. It is a tool which uses semantic mapping to develop concept maps from natural language. Therefore, Leximancer can assist in discovering new information from the text. In their attempt to validate the output and methods used by Leximancer (in terms of face validity, stability, reproducibility), Smith and Humphreys (2006) found encouraging results.

Leximancer software conducts two types of content analysis: conceptual and relational content analysis. “In conceptual analysis, documents are measured for the presence and frequency of concepts. […] Relational analysis, by contrast, measures how such identified concepts are related to each other within the documents” (Leximancer 2010). The tool generates word lists from term-occurrence information as co-occurrence, positions, and frequencies of nouns and verbs in the text. Themes are the colored circles which group clusters of concepts. Themes are "heat-mapped," meaning that red colors denote important themes, blue colors denote least relevant themes. The relative co-occurrence showed by a concept map may support the information sought, but can also reveal unexpected relationships. “Visually emergent concept groups are referred to as themes” (Watson, Smith and Wattner 2005).

Content analysis with Leximancer

“Content analysis is a research technique for making replicable and valid inferences from texts to the contexts of their use” (Krippendorf 2004: 18). We focus on content and concerns of the researchers' discussions on environmental performance. Hence, we want to identify the most salient concepts and themes emerging from the different fields of research.

[2] Conceptually related concepts are grouped by a theme. "Concepts in Leximancer are collections of words that generally travel together throughout the text" (Leximancer 2010:9). More details on how concepts and themes are generated by Leximancer can be found in Leximancer (2010).

As one main goal of CAQDAS is to make us aware on the global context and significance of concepts (Smith and Humphreys, 2006: 262), we analyzed the complete papers, not only special parts of the text (abstracts, hypothesis section, etc.). This is due to the fact that only few studies provide a “real” definition of environmental performance. Furthermore, we want to illustrate a broader picture of the literature on environmental performance. It is important to note that the analysis with Leximancer does not generate an overall definition of environmental performance. Instead, it provides a general impression on the items and language used to explore this research topic. Finally, as Smith and Humphreys (2006) state, "a word can be defined by its context in usage." Thus, the method of CAQDAS assists in deriving a definition of CEP from extant literature.

We conducted two types of analysis. First, we ran a conceptual analysis (or thematic analysis) which detects and quantifies concepts in the text. Frequently used terms (seed words) are identified as potential starting points of concepts. “Seed words are named as such because they start out as being the central terms of a concept definition” (Leximancer, 2010: 61). At that stage, we did not manually define seed words. Leximancer automatically identified all seed words. After that automatic extraction, we edited the emergent concept seeds by removing concepts like linking words or frequently used verbs (e. g. “and”, “to” or “based”) and merging similar-looking concepts like “environmental” and “environmentally”, “study” and “studies” or “develop” and “developing”. The following thesaurus learning phase is an iterative process which generates a thesaurus of terms associated with each concept. Starting with the seed words as central terms of a concept relating keywords are collected over time. After the learning phase we created the compound concept “environmental performance” via the Boolean operator “AND,” meaning that this concept is treated as a singular concept from this stage onward. Finally, the results are displayed in a concept map and rank lists. These last two steps belong to the relational (or semantic) analysis which

measures the relationships (co-occurrence) between the identified concepts. “To prevent concepts from being perceived to be related across changes in context […], the co-occurrence is only measured within (and not across) blocks […] containing three sentences” (Leximancer, 2010: 48). The co-occurrence of concepts (cognitive mapping) is stored in a co-occurrence matrix and visually displayed in the concept map. The brighter a concept is displayed on the map, the more frequently it appears in the text. The nearness in the map indicates that two concepts appear (co-occur) in similar conceptual contexts.

Findings

Leximancer usually generates rather lengthy concept lists. However, we did not limit the number of concepts in order to produce a comprehensive view of the literature. The first three columns of Table 5 contain the ranked concept list for the conceptual analysis of the two clusters, empirical studies and conceptual papers. The concepts are rank-ordered according to the number of occurrence and frequency in the texts analyzed. The list contains 74 concepts with relative counts ranging from 13,315 instances (100%) to 239 instances (2%). It is not surprising that the first three concepts “environmental”, “performance," and “environmental and performance” are most frequent. The concept “environmental and performance” was defined by the authors by merging the concepts “environmental” and "performance.” This means we look especially for the phrase “environmental performance.” The concepts “environmental” and “performance” reflect only these words themselves, which implies that both terms can be found the text independently. Interesting is that the terms “facilities,” “management,” and “use” are ranked next. A closer examination of these terms reveals that “facilities” and “use” are most relevant in empirical studies referring to the level of analysis (facility, company, or firm level) and proposing adequate measures (“we use…” as well as “use of resources”). These results from content analysis are purely based on the count of terms in the text. Therefore, we conducted a relational analysis to investigate how closely the

concepts are related to each other and how often the concepts and terms appear close to each other. We selected the concept "environmental performance" to investigate how the other concepts are related to it. With the selection of this concept we identify the likelihood of the co-occurrence of the concepts. The results of the relational analysis are shown in the last three columns of Table 5. The list contains relative counts from 3,325 instances (100%) to 52 instances (10%) with "performance" being most closely connected to environmental performance. Of interest is that all other terms follow with significantly lower counts. The terms "measures," "indicators," and "economic" are ranked as the next important ones, but with smaller counts (427, 434, and 224, respectively). It is important to notice that the relational analysis does not order the concepts in their absolute counts, but on their likelihood to contextually occur with environmental performance. Because we chose the concept "environmental performance" each separate item "environmental" and "performance" occurs with 3,325 counts. In contrast to "environmental," which only has a likelihood of 25% to co-occur with environmental performance, "performance" has a likelihood of 100% indicating that the term environmental is also used in many other contexts.

(Insert Table 5 about here.)

Furthermore, the themes and concepts derived are also visually mapped in Leximancer's concept map, as shown in Figure 1. This concept map is a bird's eye view of the data, displaying the main concepts and their relationships. Within the themes the different concepts are clustered. The concepts printed in bold are the most frequent terms. The concept map is an illustration of the conceptual and relational analysis in Table 5. The concept map illustrated applies a theme size of 55% and 100% visible concepts.[3] Our two clusters conceptual and empirical papers can also be found on the concept map represented by the

[3] With Leximancer we can use different theme sizes which address the generality of the themes. We chose a theme size of 50%. We display all concepts on the map (100% visibility) that means all identified concepts are found on the map, not only the most frequent ones.

concepts Folder_1 (conceptual) in the lower left and Folder_2 (empirical) in the upper right. This allows a more specific exploration which concepts are characteristic for each cluster. We analyzed both clusters in separate folders. These folders become concepts on the map along with all other concepts. Concepts coming from the content of our conceptual papers will tend to settle near the concepts "Folder_1_conceptual_papers": e.g., "indicators," "social," "responsibility," "energy," "measures," "approach," and "companies." In contrast, the concepts that settle near Folder_2 are "variables," "disclosures," "facilities," "participation," "releases," "government," etc. This shows that empirical and conceptual papers seem to refer to different contexts. However, the concept of environmental performance occurs in an approximately similar frequency in both folders.

(Insert Figure 1 about here.)

We identify nine major themes on the map: management, facilities, participation, business, environmental, firms, variables, companies, and use. The themes environmental, use, facilities and companies are the most frequent of them. "**Environmental**" comprises information, impact(s), performance, process, activities, study, research, public, areas and time. This concept stands for the result of the use of the environment, i.e., the *environmental impacts* caused by the activities of the company in a certain area for a specific period of time. "**Use**" reflects the use of materials, energy, water, paper, air, but also emissions and waste. This concept identifies specifically the data of *inputs and outputs* of a company within an industry on different levels of analysis, for example, the production process using different models. The term "**facilities**" is focusing on the words compliance, regulatory, voluntary, program, government, environmental management system (EMS) and ISO. The objects relevant for environmental performance are concrete facilities that have to be managed by *operations management*, guaranteeing compliance and managing the environmental program. "**Management**" is including standards, implementation, systems, organization policy,

managers and employees. So, this concept is mostly related with *strategic management*, describing how environmental performance can be managed and controlled. "**Companies,**" often the starting point for conceptual papers, describe approaches, measures, indicators, products, cases, strategies and the environment. Our whole analysis focuses on the *company level*; that is, why we excluded papers on the national or industry level. "**Firms,**" primarily used in empirical papers, often describe the population analyzed with terms like sample, size, total, results, survey, costs and disclosures. Thus, similar to the term "companies," the term "*firms*" is used to set the boundary for analysis. "**Business,**" mainly used in conceptual studies, is identified as a minor concept by Leximancer, describing the specific corporate responsibility, development, quality, and work. As a concept, "business" also focuses more on the description of the objects of analysis, we merge the concepts of firms and businesses in our model. "**Variables**" describe the releases, sizes, and sample. This term is used to describe mainly empirical studies, but it does not add any additional information value to our synthesizing concept model. "**Participation**" seems to indicate the importance of *stakeholder management* in the academic literature as a major driver of environmental management. In particular, one stream of the empirical literature investigates how far participating in environmental programs influences CEP.

It is apparent that our two clusters of empirical and conceptual studies are related to rather different concepts as they do not settle together on the map. This bifurcation may be a function of the embryonic state of this literature (see also Orlitzky, Siegel, & Waldman 2011). Fragmentation and balkanization often characterize literatures without discernable cumulative research programs (Cohen 1989). Without a concerted effort at a more integrative research effort, scientific progress will probably be slow (Lakatos & Musgrave 1970).

Towards a conceptual framework for CEP

From our content analyses, we derived a lot of heterogeneous definitions and measures of CEP. The explicit definitions we found refer to the management of a firm's environmental

aspects as well as stakeholder expectations. In addition, the implicit definitions of CEP revealed environmental management activities, result and process-oriented measures. The method of CAQDAS broadens the view on CEP and provides further frequently used terms relating to CEP.

Merging the concepts revealed by the Leximancer concept map and the explicit and implicit definitions of CEP found one may develop the following cybernetic model describing CEP (see Figure 2).

(Insert Figure 2 about here.)

Comparing our findings from CAQDAS and the extracted definitions from the literature, we can identify some common elements. For example, the concept “use” can be attributed to the measurable outcomes like emissions, use of resources, materials, and energy. The concept “management” can be compared with organizational aspects like managing the environmental aspects of a company. However, with CAQDAS, we find only weak evidence for managing and meeting the stakeholder expectations. Only within the theme “facilities” do we find concepts like compliance, regulatory, and program, which indicate a certain engagement in environmental programs of the government. Therefore, stakeholder management must also be included in our model of CEP. Synthesizing the existing definitions of CEP with CAQDAS results not only in a comprehensive, but also parsimonious model of CEP. The description of our model derived from our Leximancer analysis and the explicit and implicit definitions can start anywhere in the cybernetic cycle presented in Figure 2. But we will start our explanation with the environmental impacts. Stakeholders are affected by the companies' environmental impacts, for example, climate change. Consequently, they put pressure on companies (e.g., by organizing themselves) to reduce the causes of those impacts. If companies decide to cater to the demands of the most urgent and powerful stakeholder groups (Mitchell, Agle, & Wood 1997), they may choose to integrate them in their strategic

management and later on in their operations management (identify and management the environmental aspects of a company). Inputs and outputs of the processes (see concept “use” in Leximancer map: use of materials, energy, water, etc.) and the company as a whole depend on operations management, i.e., the facilities, the environmental program, based on regulatory and voluntary targets. And finally the inputs and outputs of a specific firm eventually determine the environmental impacts caused by the company.

Following Schwab (1980), for a scientific application, both the independent and the dependent variables are in the focus equally (Schwab 1980, pp. 6 ff.). So research could analyze any relationship of two or more of the dimensions displayed in the figure. For an applied orientation, the dependent variable is of greater importance. Therefore we decided to integrate both perspectives in our model: for scientific applications all variables might be analyzed in relation to all other variables. Therefore all possible directions might be interesting (dotted two-ended arrows). For an applied orientation we chose the presentation of a cybernetic model following the Deming-cycle (ISO 14001) as the basis for environmental management system in the standardization process (solid one-ended arrows).

6. Discussion

From our analysis of 165 studies we can identify the following shortcomings of prior literature on CEP. A theoretical background is often missing because less than 10% (14 out of 165) of the studies present a clear definition of CEP. The remaining papers provide only a verbal description of CEP (e.g., how CEP is measured—by specific indicators or items)—in that particular investigation). A lot of empirical research lacks a strong theoretical basis. Moreover, environmental performance is often reduced or equated to environmental performance measurement, meaning CEP is operationalized without careful consideration of its theoretical basis. This radical operationism raises concerns about construct validity. Future research should take this into account and have a stronger focus on the theoretical explanation

of CEP before conducting any empirical analysis. Hence, this should also be seen as an opportunity to develop theory. The parsimonious model proposed in this paper is one such possible step towards theorizing. Moreover, parallel to the environmental performance literature, a second research stream has developed as it cannot be denied that environmental issues are a part of the broader concepts of sustainability or corporate social responsibility. An analysis concerning social responsibility can be found in Dahlsrud (2007), for instance.

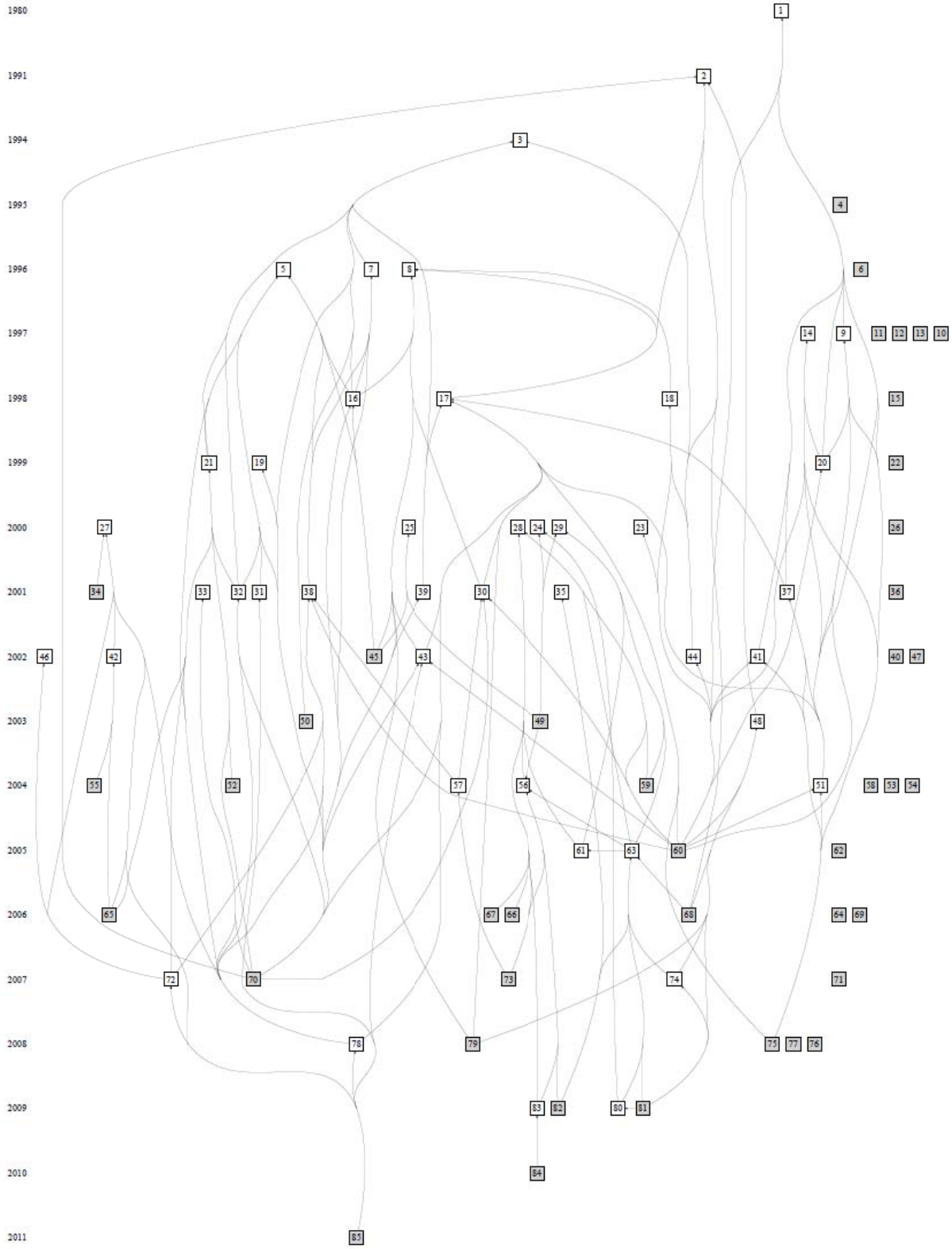
7. Conclusion

Conducting content analysis of 165 studies and semantic mapping of 85 studies, we find that environmental performance is used in a diversity of contexts and is only rarely defined clearly. Although our analysis covers publications from 1980 until 2010, we conclude neither that a consensus about its definition has developed nor that a more precise meaning or a specific contextual usage is apparent. This is evident from our Histcite analysis which revealed that especially empirical work is not grounded in prior theoretical approaches. In fact, most empirical investigations rely on prior measures or proxies without analyzing what CEP might mean in the context of a specific research question. Therefore, we have to agree with the Spencer-Cook's (1994) conclusion, which still seems to be true today even after 17 years of research: “There is an intrinsic limitation in dealing with concepts such as 'corporate environmental performance' […], since there exist at present no generally accepted definitions/or these terms” (Spencer-Cook 1994).

A further key aim of our paper was to illustrate how CAQDAS can further assist in exploring the research work on CEP conducted so far. We also recognize that CAQDAS cannot substitute researchers' interpretation of the data, but it may enrich the research process. But combined with the researcher`s interpretation we could gain considerable results and could deduct a comprehensive model for CEP. We find six major elements describing CEP: environmental impacts that are caused by firm activities (operations management and

inputs/outputs) as well as strategic elements that manage stakeholder expectations. Furthermore, we find that studies investigating the relationship between CEP and CFP apply more pollution-oriented measures of CEP because they can be related to financial consequences like fines and penalties. This eco-efficiency view differs from the classic environmental research literature. Therefore, we have to consider that we limited our selection to CEP in a relatively narrow sense. Especially for CAQDAS we excluded studies that investigate the relationship between CEP and CFP because of the different aims of research. A more interdisciplinary perspective on CEP might provide further useful insights or refinements of the concept CEP.

Appendix 1: Historiograph of empirical and conceptual papers



Appendix 2: List of all records of Histcite analysis

No.	Authors	Year	Cited References*	LCR*	LCS*
1	Ingram et al.	1980	-	0	7
2	Wood	1991	-	0	5
3	James	1994	-	0	8
4	Brophy et al.	1995	-	0	0
5	Azzone et al.	1996	-	0	8
6	Metcalf et al.	1996	-	0	0
7	Tyteca	1996	James (1994)	1	3
8	Lober	1996	-	0	8
9	Li et al.	1997	Ingram (1980)	1	4
10	Freimann et al.	2001	-	0	0
11	Naimon et al.	1997	-	0	0
12	Larson et al.	1997	-	0	0
13	Russell et al.	1997	-	0	0
14	Barth et al.	1997	-	0	4
15	Souitaris et al.	1998	-	0	0
16	Young et al.	1998	James (1994); Lober (1996); Tyteca (1996); Azzone et al. (1996)	4	2
17	Ilinitch et al.	1998	Lober (1996); Wood (1991)	2	10
18	Judge et al.	1998	Lober (1996)	1	2
19	Dixon et al.	1999	-	0	1
20	Cormier et al.	1999	Barth et al. (1997); Li et al. (1997); Ingram (1980)	3	1
21	Thoresen	1999	Azzone et al. (2000); James (1994)	2	6
22	Hopkinson et al.	1999	-	0	0
23	Atkinson et al.	2000	-	0	1
24	Darnall et al.	2000	-	0	2
25	Steger	2000	-	0	2
26	Theyel	2000	-	0	0
27	Jasch	2000	-	0	6
28	Dasgupta et al.	2000	-	0	9
29	Welch et al.	2000	-	0	4
30	Gerde et al.	2001	Lober (1996); Ilinitch et al. (1998)	2	3
31	Johnston et al.	2001	Azzone et al. (2000)	1	1
32	Dias-Sardinha et al.	2001	Azzone et al. (2000); James (1994); Thorensen (1999)	3	2
33	Pojasek	2001	-	0	2
34	Scherpereel et al.	2001	Jasch (2000)	1	0
35	Hamschmidt et al.	2001	-	0	1
36	Freimann et al.	1997	-	0	0
37	Hughes et al.	2001	Ilinitch et al. (1998); Ingram et al. (1980)	2	2
38	Olsthoorn et al.	2001	Azzone et al. (2000); Tyteca (1996)	2	5
39	Jung et al.	2001	James (1994); Ilinitch et al. (1998)	2	1

40	Russo	2002	-	0	0
41	Patten	2002	Ingram (1980)	1	2
42	Tam et al.	2002	Jasch (2000)	1	2
43	Kolk et al.	2002	Lober (1996),; Ilinitch et al. (1998)	2	3
44	Banerjee	2002	James (1994); Wood (1991); Judge et al. (1998)	3	1
45	Fryxell et al.	2002	Steger (2000); Azzone et al. (1996); Lober (1996); Young et al. (1998)	4	0
46	Pineda-Henson et al.	2002	-	0	1
47	Vanek	2002	-	0	0
48	Melnyk et al.	2003	Wood (1991)	1	5
49	Andrews	2003	Steger (2000); Welch et al. (2000); Anton et al. (2004); Darnall et al. (2000)	4	0
50	Levebvre et al.	2003	James (1994)	1	0
51	Al-Tuwaijri et al.	2004	Barth et al. (1997); Hughes et al. (2001); Ilnitch et al. (1998); Li et al. (1997); Ingram et al. (1980)	5	2
52	Tam et al.	2004	Thorensen (1999)	1	0
53	Gallagher et al.	2004	-	0	0
54	Hillary	2004	-	0	0
55	Christini et al.	2004	Tam et al. (2002)	1	0
56	Anton et al.	2004	Dasgupta et al. (2000)	1	5
57	Szymansky et al.	2004	Gerde et al. (2001); Olsthoorn et al. (2001)	2	1
58	Hertin et al.	2004	-	0	0
59	Rivera et al.	2004	Dasgupta et al. (2000); Welch et al. (2000)	2	0
60	Perego	2005	Al-Tuwaijri et al. (2004); Barth et al. (1997); Cormier et al. (1999); Dasgupta et al. (2000); Judge et al. (1998); Li et al. (1997); Melnyk et al. (2003); Patten (2002); Atkinson et al. (2000); Banerjee (2002); Gerde et al. (2001); Ilinitch et al. (1998); Olsthoorn et al. (2001); Ingram et al. (1980); Kolk et al. (2002)	15	0
61	Potoski et al. (b)	2005	Dasgupta (2000); Welch et al. (2000)	2	1
62	Doonan et al.	2005	-	0	0
63	Potoski et al. (a)	2005	Anton et al. (2004); Dasgupta et al. (2000); Welch et al. (2000); Potoski et al. (2005b);	4	5
64	Henri et al.	2006	-	0	0
65	Tam et al.	2006	Jasch (2000); Tam et al. (2002); Thorensen (1999)	3	0
66	Gangadharan	2006	Dasgupta et al. (2000)	1	0
67	Seroa da Motta	2006	Dasgupta et al. (2000)	1	0
68	Link et al.	2006	Melnyk et al. (2003); Potoski et al. (2005a); Wood (1991)	3	0
69	Shadbegian et al.	2006	-	0	0
70	Xie et al.	2007	Azzone et al. (1996); Dias-Sardinha et al. (2001); Dixon et al. (1999); Gerde et al. (2001); James (1994); Kolk et al. (2002); Lober (1996); Olsthoorn et al. (2001); Pojasek (2001); Thorensen (1999); Tyteca (1996); Young et al. (1998); Ilinitch et al. (1998); Jung et al. (2001); Wood (1991)	15	0
71	Sullivan et al.	2007	-	0	0

72	Hermann et al.	2007	Jasch (2000); Olsthoorn et al. (2001); Pineda-Henson et al. (2002); Thorensen (1999)	4	1
73	Barla	2007	Anton et al. (2004); Dasgupta (2000); Szymanski et al. (2004)	3	0
74	Boiral	2007	Melnyk et al. (2003); Potoski (2005a)	2	1
75	Clarkson et al.	2008	Al-Tuwaijri et al. (2004); Barth et al. (1997); Ilinitch et al. (1998); Li et al. (1997); Patten (2002); Hughes et al. (2001); Ingram et al. (1980)	7	0
76	Bi et al.	2008	-	0	0
77	Niemeijer et al.	2008	-	0	0
78	Perotto et al.	2008	Dias-Sardinha et al. (2001); Azzone et al. (1996); Olsthoorn et al. (2001); Jasch (2000); Pojasek (2001); Ilinitch et al. (1998); Thorensen (1999)	7	1
79	Henri et al.	2008	Ilinitch et al. (1998); Melnyk et al. (2003); Lober (1996)	3	0
80	Russo	2009	Potoski et al. (2005a); Darnall et al. (2000)	2	1
81	Yin et al.	2009	Melnyk et al. (2003); Potoski et al. (2005a); Russo (2002); Boiral (2007)	4	0
82	Nawrocka et al.	2009	Potoski et al. (2005a); Anton et al. (2004); Hamschmidt et al. (2001)	3	0
83	Sam et al.	2009	Anton et al. (2004); Dasgupta et al. (2000)	2	1
84	Vidovic et al.	2010	Sam et al. (2009)	1	0
85	Hourneaux et al.	2011	Hermann et al. (2007); Jasch (2000); Johnston et al. (2001); Kolk et al. (2002); Perotto et al. (2008)	5	0

*** LCS= Local Citation Score, LCR= Local Cited References**

Figures and Tables

Table 1:

Distribution of the selected articles on different journals.

	Number of articles per year of publication																	
	1980	1991	1994	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Totals
Business Strategy and the Environment			1	1		1		1	1	1					1		2		9
Journal of Cleaner Production							1	1	2			1			1	1	1		8
Environmental Quality Management				1	3			1	1										6
Greener Management International							1		3			1							5
Eco-Management and Auditing					1				2						1				4
Accounting, Organizations and Society										1		1				1			3
Ecological Economics													1	2					3
Journal of Environmental Economics and Management								1				1			1				3
Journal of Environmental Management				1						1						1			3
Journal of Policy Analysis and Management								1					1						2
Building Research & Information										1		1							2
Journal of Accounting and Public Policy						1			1										2
Academy of Management Review		1																	1
American Journal of Political Science													1						1
CMA Management														1					1
Construction Management and Economics														1					1
Contemporary Accounting Research					1														1
Corporate Environmental Strategy							1												1
Corporate Social Responsibility and Environmental Management															1				1
Ecological Indicators																1			1
European Management Journal								1											1
IEEE Transactions on Engineering Management														1					1
International Journal of Operations & Production Management								1											1
Journal of Accounting, Auditing and Finance							1												1
Journal of Accouting Research	1																		1
Journal of Business Research										1									1
Journal of construction engineering and management												1							1
Journal of Environmental Assessment Policy and Management							1												1
Journal of Industrial Ecology											1								1
Journal of Management Studies						1													1
Journal of Managerial Issues				1															1
Journal of Operations Management											1								1
Journal of Productivity Analysis														1					1
Land Economics																	1		1
Organization Science															1				1
Policy Reform												1							1
Review of Accounting Studies					1														1
R&D Management											1								1
Sustainable Development										1									1
The Policy Studies Journal												1							1
Other										1	1	2				2		1	7
Totals	1	1	1	4	6	3	5	7	10	7	4	10	3	6	6	6	4	1	85

Table 2:

Explicit definitions of CEP in the selected literature

Literature	Explicit definitions of CEP
Judge (1998)	"We define environmental performance as a firm's effectiveness in meeting and exceeding society' expectations with respect to concerns for the natural environmental. This desired end would extent beyond mere compliance with existing regulations to a proactive stance concerning future environmental considerations. [...] Environmental performance was conceptualized as the organization-wide commitment to environmental excellence relative to the rest of the industry in a variety of areas."
*Klassen (1999)	"A common definition of environmental performance has been based on the quantity of pollutants released from a plant…".
Jasch (2000)	Reference to ISO definition: results of an organization's management of its environmental aspects
*Lankoski (2000)	"Environmental performance refers to the level of harmful environmental impact caused by a firm so that the smaller the harmful environmental impact the better the environmental performance and vice versa."
*Johnston (2001)	Reference to ISO definition: results of an organization's management of its environmental aspects
*Wagner (2003a)	"The environmental performance of a company can be defined by means of a firm's physical performance with regard to environmental aspects based on physical environmental performance indicators."
*Elsayed (2006)	"While environmental responsiveness refers to the strategic positioning of the firm claim towards its environment responsibility (i.e., its environmental strategy), environmental performance expresses actually what the firm did."
Hourneaux (2008)	"[…] measurable outcomes of managing an organization about its environmental aspects."
*Salo (2008)	"Therefore, environmental performance is defined by those factors that add to or protect financial value, because they are the ones most important to shareholders and firm management. These factors include: current environmental liabilities and risk exposure, potential to harness environmental business opportunities, firm ability to manage environmental risks and opportunities, the use of environmental management systems (EMSs), environmental performance monitoring and accounting systems, and the quality of environmental reporting."
*Ienciu (2009)	The concept of environmental performance pertains to the level of harmful environmental impact caused by the activities of a firm. As the activities of a firm can have different environmental impacts, the concept of environmental performance is a vector of those impacts. Environmental impacts occur through land use, resource use, and pollutant releases into air, water, and land throughout the life-cycle of a product.
*Lopez-Gamero (2009)	„The output of environmental management is environmental performance."
Nawrocka (2009)	According to ISO: "measurable results of an organization's management of its environmental aspects"
*Clemens (2010)	Environmental performance is a multidimensional construct with factors including environmental impact on the biosphere, customers, employees, the local community, and other stakeholders
*Yang (2010)	"Environmental performance refers to the organization's performance with respect to their environmental responsibilities."

Table 3:

Implicit definitions of CEP from conceptual studies

Literature	Implicit definitions, i.e. verbal descriptions of environmental performance in conceptual papers
Azzone (1996)	External environmental effectiveness; company's environmental efficiency; company's 'green' image; firm's environmental flexibility
Banerjee (2002)	Corporate environmentalism is the organization-wide recognition of the legitimacy and importance of the biophysical environment in the formulation of organization strategy, and the integration of environmental issues into the strategic planning process
Boiral (2007)	Case study with in different sectors with "main environmental problems": emissions of: VOC, CO2, SF6, dust and fluorides, water consumptions, oil spills, energy consumption, discharges of CSS and BOD, wood transportation and residues, soil contamination
Darnall (2001)	"questionnaire about improved environmental performance, no definition provided
Delmas (2010)	environmental impacts (toxicity, emissions, energy use, etc.), regulatory compliance (violations, fines, non-compliance status) and organizational processes (accounting, audits, reporting, management system)
Dias-Sardinha (2001)	compliance performance: evaluation of the adequacy of supply human resources and structure for implementation of regulations, when required by law, implementation of environmental management system (EMS) and/or preparation for calamities, quality of gathered data as to actual compliance, evaluation of emissions, quality of products and workplace as required by regulations or voluntary agreements, control equipment as required by law, records of violations of regulations, voluntary agreements
	pollution prevention performance: evaluation as in compliance plus evaluation of provision of budget, expertise and manpower for, pollution prevention activities, process of looking for preventive technologies and practices outside own organization, efficiency pollution prevention program, frequency of maintenance procedures, results of pollution prevention investments and other changes
Dixon (1999)	EcoValue 21 environmental rating methodology
Ringling Gallagher (2004)	environmental performance outcomes e.g. use of energy, water, materials
Gerde (2005)	presentation of comprehensive databases including measures of environmental performance: TRI, KLD, CEP, EIS, (IRRC) (p. 272)
Henri (2006)	use of matrix from Ilinitch(1998)
Hermann (2007)	concentration of´n EPIs: Environmental performance indicators (EPIs) measure the current or past environmental performance of an organisation and compare it to the targets set by the organisation's management
Hopkinson (1999)	unsatisfactory combined sewer overflows,(ii) bathing waters non-compliance,(iii) equivalent population served by sewage treatment works in breach of consent and unsatisfactory sea outfall, (iv) successful prosecutions,(v) Category 1 and 2 pollution incidents.
Hourneaux (2008)	measurable outcomes of managing an organization about its environmental aspects; application of GRI indicators: Indicators relating to materials (use and recycling). Indicators relating to energy (direct or indirect energy consumption). Indicators relating to water (withdrawal by source/ spring). Indicators for biodiversity (biodiversity value and impacts on areas owned or administered by the organization). Indicators relating to emissions, effluents and waste, Indicators relating to environmental aspects of products and services (the mitigation of environmental impacts and recovery of packaging). Indicators relating to environmental compliance (fines and penalties for environmental non-compliances). Indicators relating to transportation (impacts of transporting goods and workers). Indicators relating to general environmental issues (investment on environmental protection).
Ilinitch (1998)	(1) organizational systems; (2) stakeholder relations; (3) regulatory compliance; and (4) environmental impacts.
Ingram (1980)	CEP indices of air and water emissions
James (1994)	different measures: risk (e.g. consequences of harmful events), impacts (BOD), emissions/wastes /TRI), inputs, resources (consumption of energy, water, biological

	resources), efficiency (comparing material inputs with valueless waste outputs), customer, financial (avoided costs),
Jasch (2000)	ISO definition (management system evaluation, operational system evaluation and state of the environment evaluation
Johnston (2001)	ISO definition (management system evaluation, operational system evaluation and state of the environment evaluation
Jung (2001)	General environmental management (policies, information systems, auditing), inputs (materials, energy), process/operations (product design, employee training, reuse/recycling, new technologies), outputs (resource savings, emissions of air/water/land pollutants, wastes, workplace safety, health, noise, radioactive substances), outcomes (financial, fines, expenditures, avoided costs, liabilities, non-financial:complaints, law suits, press reports, contributions to local community)
Kolk (2002)	review of models from Ilinitch and ISO14031
Larson (1997)	quantitative (result-oriented measures), qualitative (process-oriented measures)
Lober (1996)	24 environmental performance evaluation criteria: environmental policy, code of environmental ethics and standards, corporate structure, employee involvement, environmental management system, total quality environmental management, materials, energy, water usage, pollution prevention, waste minimization, recycling activity, product and process stewardship, environmental accounting of benefits and costs, environmental auditing, environmental releases, sustainable relationship with natural ecosystems, environmental liabilities, compliance and penalties, accidents, relationship with public/media, relationships with local community, shareholders, suppliers, environmental groups, political system, participation in cooperative environmental councils and partnerships, communication of environmental activity, industrial ecology
Metcalf (1996)	Environmental performance indicators in 4 areas: environmental compliance, training, enhancements, program effectiveness
Perotto (2008)	ISO definition ("measurable results of an organization's management of its environmental aspects)
Olsthoorn (2001)	Productive efficiency indicators, management indicators
Pojasek (2001)	Application of the Baldrige Model
Russell (1997)	2 dimensions: environmental program dimension (air & water quality, waste management, energy efficiency), EMS element dimension (policy & commitment, planning, implementation, monitoring & measurement, review & improvement)
Scherpereel (2001)	Set of environmental performance indicators in 3 categories: resource savings, impact minimizing, environmental management
Tam (2002,2004, 2006)	Environmental operational indicators (=physical facilities and equipment, and the supply to and delivery from them, during the production process, e.g. energy , wastes, emissions), environmental performance indicators ("reflect the output performance of a project: they are used for evaluating the efficiency and effectiveness of environmental management systems.", e.g. site environment, compliance, auditing activities)
Thoresen (1999)	Product lifecycle performance; management system performance; manufacturing operations performance
Xie (2007)	environmental management performance (organizational system, stakeholder relations, operational countermeasures and environmental tracking) environmental operational performance (inputs and outputs)
Young (1998)	environmental policy; (2) environmental management system; (3) environmental impacts of processes, products/services

Table 4:

Verbal descriptions on measurement of CEP in empirical literature and CEP-CFP studies (marked with *) (M=measurements, D=definitions)

Empirical Literature	Measurement of CEP
Wiseman (1982)*	M: environmental performance measures compiled by the Council on Economic Priorities (CEP).
Johnson,S. D. *(1995)	M: TRI (fugative, stack, total air emission; water and land emission; underground injection; discharges to publicly -owned treatment works; total discharges) normalized by annual sales revenue, $ value of env. fines and violations normalized by..., no. superfunds, no. of RCRA corrective actions, vol. oil&chemical spills, CEP Rating
Hart (1996)*	M: TRI emissions
White (1996)*	M: Information collected and published by the Council on Economic Priorities (CEP) was used to proxy a firm's environmental reputation
Barth (1997)	M: Environmental liabilities
Cohen (1997)*	M: Nine different measures: number of env.litigation proceedings, Superfund sites, number and value of non-compliance penalities, volume of toxic chemical releases (TRI), number and volume of oil and chemical spills
Cormier (1997)*	M: Pollution measure: water pollution
Day (1997)*	M: Data from TRI
Konar, S. (1997, 2000)*	M: Data from TRI
Li (1997)	M: Pollution control index of CEP
Naimon (1997)	D: "Defining environmental performance and risk explicitly appears to be a requirement for the development of more comprehensive explanations of the observed relationships"
Al-Tuwairij (1998)	M: ratio of toxic waste recycled to total toxic waste generated
Edwards (1998)*	M: Disclosure, greenhouse gases, ozone depleting substances, packaging and labeling, resource use, corporate environmental policy, environmental management systems, monitoring environmental impacts, energy efficiency, env. Responsibility, env. Communication, compliance
Bhat (1998)*	M: Penalties assessed for violations of environmental regulations
Gottsmann (1998)*	M: Substances released to the environment, compliance
Ilinitch (1998)	M: 1) organizational systems; (2) stakeholder relations; (3) regulatory compliance; and (4) environmental impacts.
Judge (1998)	D: "We define environmental performance as a firm's effectiveness in meeting and exceeding society' expectations with respect to concerns for the natural environmental. This desired end would extent beyond mere compliance with existing regulations to a proactive stance concerning future environmental considerations. [...] Environmental performance was conceptualized as the organization-wide committment to environmental excellence relative to the rest of the industry in a variety of areas." (p.245, 251)
Khanna, M. (1998)*	M: Event (release of TRI data), TRI, no. of superfund sites
Stanwick, P.A. (1998a)*	M: Fortune Corporate Reputation Index. (CSP), environmental performance as pollution emissions/annual sales level (ENPERF) (TRI)
Cormier (1999)	M: Excess pollution, fines, penalties
Khanna, M. (1999)*	M: Participation in EPA´s 33/50 program, TRI, no. of superfund sites
Christmann, P. (2000)*	M: Chemical releases from TRI
Dasgupta (2000)	M: compliance
Gilley (2000)*	M: Environmental announcements on corporate environmental initiatives
Karagozoglu, N. (2000)*	M: Comparison with competitors: use of recyclable materials, efficient use of materials and resources, energy efficiency, reduction of environmentally hazardous substances, pollution prevention
Theyel (2000)	M: Reduction of chemical waste
Welch (2000)	M: CO2, NOx, SO2 emissions
Alvarez Gil, M.J. (2001)*	M: Env. Management 7 items: quantification of environmental costs and savings, environmental training programs, deployment of green purchasing policies, use of green arguments in marketing campaigns, demands for customer cooperation in environmental protection programs (e.g., voluntary

	change of towels), adoption of energy- and water-saving actions, and selective collection of paper, oil, glass, and other materials)
Azomahou (2001)*	M: Resource consumption, emission levels: emissions of chemical oxygen demand, SO2, NOx, environmental index
Berkhout, F (2001)*	M: waste, air emission, water emission, water input, energy input
Hughes (2001)	M: CEP ranking (Council on Economic Priorities)
King (2001)*	M: Total and relative emissions, industry emissions
Lysyuk (2001)*	M: Index of Corporate Environmental Engagement
Nakamura, M. (2001)*	M: EMS certification (ISO 14001), Env. Commitment, principles used in environmental affairs (env. Policy and implementation of policy)
Thomas, A. (2001)*	M: adoption of environmental policies/ prosecution / env. Training (from survey)
Earnhart (2002)*	M: Air pollutant emissions
Fryxell (2002)	M: self-report item, respondents were asked whether they agree with statement 'The environmental performance of my facility has improved as a result of obtaining certification to ISO 14001'
Mahoney (2002)*	M: Rating criteria from Michiael Jantzi Research Associates, Inc. CSID database: env. Management,planning and impact assessment, resource use,impact reduction, products and services, compliance
Molloy, L. (2002)*	M: TRI (toxic chemical emission in pound/revenues in thousand of $) of 1998, penalties in $payed/revenue in $ 1997-1999
Patten (2002)	M: Toxic releases
Russo (2002)	M: TRI data
Toms (2002)*	M: reputation of US corporations by reference to Council on Economic Priorities (CEP) ratings
Andrews (2003)	M: Baseline protocol, indicator set
Levebvre (2003)	M: Product life cycle management score, EMS, environmental R&D
Melnyk (2003)	M: reduction of waste, use of environmental options like: reduce, rebuild, recycle, waste segregation
Wagner, M. (2003b)*	M: env. Performance as reduction index based on the mean score (Questions about the degree to which env. Management activities reduced the companies env. Impact from 1998-2000)
Anton (2004)	M: total toxic emissions-sales ratio
Filbeck (2004)*	M: TRI data
Hertin (2004)	M: "Eco-efficiency", different indicators according to sectors (e.g. NOx, COD, waste, SO2, energy input)
Johnstone (2004)*	M: Env. Actions regarding water, energy, resources, toxic inputs, solid wastes, soil, wastewater, noise, odour, landscape
Rivera (2004)	M: Self-assessed environmental performance
Szymanski (2004)	M: TRI data
Chan, R. Y. K. (2005)*	D: Definition from Judge (1998) M: Respondents were asked to rate their firms' overall performance in relation to competing firms in their industry on each of the following performance Measures: Complying with environmental regulations, Limiting environmental impact beyond regulatory compliance, Preventing and mitigating environmental crises, Educating employees and the public about the environment
Darnall (2005)*	M: Use of natural resources, solid waste generation, wastewater effluent, local or regional air pollution, global pollutants
Derwall (2005)*	M: Not absolute CEP but relative CEP: Eco-efficiency can be defined as the ratio of the value a company adds (e.g., by producing products) to the waste the company generates by creating that value (
Doonan (2005)	M: emissions, spills, key inputs, fines and penalties
Elsayed (2005)*	M: Management Today's evaluation criteria: community and environmental responsibility scores
Guenster (2005)*	D: "Corporate social (environmental) responsibility is a broad construct that can only be assessed with multidimensional indicators." […] "In contrast, our study builds on the concept of eco-efficiency, which is a more strictly defined construct and can be quantified by using Innovest's eco-efficiency rating methodology. As we explain, the rating is not only intended to reflect historical environmental performance, but also to identify future environmental risks and opportunities
Gupta (2005)*	M: environmental rating by India's leading environmental NGO, the Delhi-based Centre for Science and Environment (CSE)
Hassel (2005)*	M: Environmental rating from Caring Company (CC) Research performance-rating model is built on 23 criteria and aggregated into five categories. The categories on which firms are evaluated are as follow: (I) environmental objectives and strategy, includes environmental reporting(five criteria); (II) implementation of environmental processes (five criteria); (III) production-related environmental issues (five criteria); (IV) productrelated environmental issues (five criteria); and (V) service company-related issues (three criteria).
Judge (2005)*	M: Expert ratings: 1) degree of maintenance, con servation, and expansion of environmental

	resources; (2) degree of maintenance of the vitality of ecosystems; (3) degree of maintenance and increase in the production functions of the ecosystems; and (4) degree of maintenance and improvement of the socioeconomic functions and conditions.
Kassinis, G. J. (2005)*	M: Environmental management practices
Menguc, B. (2005)*	M: Survey: CSR (env. Protection)environmental commitment (content: Strategie, UMS)
Potoski (2005a)	M: Pollution emission reduction
Potoski (2005b)	M: compliance
Salama (2005)*	M: corporate reputation index of Britain's MAC which was published in Management Today is used as a proxy to measure CEP.
Brammer (2006)*	M: policies; systems; reporting; and performance. Each category graded 1 to 5.
Clemens, B. (2006)*	M: Respondents rated the extent to which they agreed that their firms green program improved green performance in comparison to their competitors
Galbreath (2006)*	M: environmentally sound production techniques, evidence of sustainability practices and reduction in emissions and waste
Ganghadaran (2006)	M: self-assessed environmental compliance (5 steps)
Link (2006)	M: Emission of pollutions, use of recycled materials and others adapted from Majumdar and Marcus, Potoski and Prakash and GRI
Seroa da Motta (2006)	M: Environmental practice index
Shadbegian (2006)	M: Emissions, SO2, BOD, TSS
Telle (2006)*	M: Emissions of pollutants
Barla (2007)	M: TSS, BOD emissions
Lee (2007)*	M: four indicators: (1) the reduction rates of water use; (2) chemical oxygen demand (COD); (3) biochemical oxygen demand (BOD); and (4) the increase of waste recycling at the production sites
Magness (2007)*	M: TRI data
Montabon (2007)*	content analysis: Data for each environmental practice was captured on a five point Likert scale, with 1 representing a low intensity of involvement with the practice, and 5 representing a high intensity of involvement. In the operational practices category, the researchers identified seven practices: recycling, proactive waste reduction, reactive waste reduction, remanufacturing, consume internally, market for waste, and money spent on environment. Eight practices were identified under tactical practices: early supplier involvement, environmental standards for suppliers, environmental audits for suppliers, environmental awards, life cycle analysis, environmental design, specific design target, and environmental risk analysis. There were five strategic practices: corporate policy, environmental mission statement, environmental department, surveillance of market, and strategic alliance.
Nakao (2007)*	M: environmental performance, Nikkei Environmental Management Survey Reports (Nihon Keizai Shimbun) published each year
Sullivan (2007)	M: PRTR data
Zhu (2007)*	M: Reduction of air emission, reduction of waste water, reduction of solid wastes, decrease of consumption for hazardous/harmful/ toxic materials, decrease of frequency for environmental accidents, improve a company's environmental situation
Bi (2008)	M: Toxic releases
Clarkson (2008)	M: TRI emissions, toxic waste
Cordeiro (2008)*	M: Data from TRI (emissions index), compliance index (total dollar amount of penalties) and spill index (combined number of chemical and oil spills) reported by IRRC (Investor Responsibility Research Council)
Galdeano-Gomez (2008)*	M: Annual expenditure on env. Practices over sales
Henri (2008)	M: Several environmental performance indicators
Mitra (2008)*	M: CEP indicators: env. Policy, env. Department, regulatory compliance, EMS certification, env. Audits, env. Cost management
Semenova (2008)*	M: pro-active operational ability of the company to handle environmental impacts and risks, such as product performance, energy use, GHG and VOC emissions, waste treatment and other initiatives.
Sharfman (2008)*	M: KLD rating
VanKooten (2008)*	M: Emissions of pollutants (methanol)
Yamaguchi (2008)**	M: Nikkei EnvironmentalManagement Ranking survey as an index of environmental performance
Berrone (2009)*	M: Basis: TRI data, calculating "human toxicity potential factor" (HTP)
Fernando (2009)*	M: TRI data, KLD rating (Kinder, Lydenberg, Domini & Co. Inc.
Ienciu (2009)*	D: The concept of environmental performance pertains to the level of harmful environmental impact caused by the activities of a firm. As the activities of a firm can have different environmental

	impacts, the concept of environmental performance is a vector of those impacts. Environmental impacts occur through land use, resource use, and pollutant releases into air, water, and land throughout the life-cycle of a product. M: There are studies that measure environmental performance by whether the firm has an environmental policy, an environmental management system, or an environmental manager of its own; whether the firm produces an environmental report or discloses environmental information; or by similar proxies. Sometimes environmental performance is measured by the absolute or relative reduction in emissions and resource use that a firm has attained.
Iraldo (2009)*	M: TRI data
Nawrocka (2009)	M: diverse (systematic review, meta-study)
Russo (2009)	M: TRI data
Sam (2009)	M: Chemical releases
Yin (2009)	M: 10 environmental aspects
Yu (2009)*	M: CEP=sustainable value
Hibiki (2010)*	M: Toxic releases
Jacobs (2010)*	M: Env. Business strategies, emissions reductions, eco-friendly products, renewable energy, recycling
Testa (2010)*	M: Questionnaire: “Has your facility experienced a change in the environmental impacts per unit of output in the last three years with respect to the following (impact)?”
Vidovic (2010)	M: Emissions of HAP, TRI and 33/50 program
Wagner (2010)*	M: Emissions and inputs
Busch (2011)*	M: Carbon performance (GHG emissions)
Clarkson (2011)*	M: Pollution propensity as toxic releases from TRI
Zeng (2011)*	M: CEP is measured in terms of contaminationcontrol andcontaminationprevention. Contamination control includes reducing contamination release, energy consumption, and selecting suppliers with good environmental protection records (Lopez-Gamero and Molina-Azorln, 2009). Contamination prevention is a long-term measure, which includes carrying out ISO 14001, cleaner production activities, staff training, and environmental audit.

Table 5:

Ranked concept lists from conceptual and relational analysis

Conceptual analysis			Relational analysis		
Word-Like	**Count**	**Relevance**	**Related Word-Like**	**Count**	**Likelihood**
environmental	13315	100%	performance	3325	100%
performance	3332	25%	measures	427	47%
environmental and performance	3325	25%	indicators	434	45%
facilities	2673	20%	economic	224	44%
management	2394	18%	corporate	352	38%
use	2364	18%	social	169	36%
firms	1896	14%	study	422	31%
companies	1770	13%	research	199	30%
data	1369	10%	systems	374	28%
study	1362	10%	compliance	240	28%
systems	1328	10%	business	171	27%
process	1174	9%	responsibility	78	27%
information	1086	8%	impact	220	27%
results	1050	8%	disclosures	267	27%
organizations	1045	8%	areas	81	26%
standard	1012	8%	information	273	25%
variables	1006	8%	environmental	3325	25%
disclosures	1001	8%	analysis	209	25%
program	1000	8%	data	337	25%
industry	998	7%	management	589	25%
indicators	962	7%	industry	245	25%
emissions	945	7%	companies	429	24%
corporate	938	7%	level	198	24%
pollution	935	7%	regulatory	179	24%
measures	916	7%	results	248	24%
compliance	861	6%	policy	128	24%
analysis	842	6%	paper	157	23%
level	821	6%	voluntary	128	23%
impact	817	6%	impacts	149	23%
products	771	6%	time	132	23%
regulatory	745	6%	issues	131	23%
costs	735	6%	standard	232	23%
model	726	5%	based	125	23%
government	721	5%	approach	93	23%
research	672	5%	use	519	22%
paper	669	5%	implementation	127	22%
reported	652	5%	development	109	22%
impacts	641	5%	process	252	21%
activities	630	5%	activities	131	21%
business	623	5%	firms	394	21%
public	598	4%	quality	81	21%
implementation	583	4%	control	90	20%
waste	578	4%	products	156	20%
production	571	4%	strategy	70	20%
issues	570	4%	public	118	20%
time	570	4%	pollution	184	20%
based	549	4%	work	52	19%
voluntary	547	4%	program	193	19%
policy	542	4%	materials	46	19%
employees	520	4%	model	138	19%
total	519	4%	organizations	196	19%
participation	517	4%	value	67	19%
economic	510	4%	waste	106	18%

development	503	4%	production	103	18%
sample	502	4%	case	76	18%
managers	475	4%	managers	82	17%
social	471	4%	support	64	17%
control	443	3%	reported	112	17%
energy	437	3%	water	73	17%
water	433	3%	survey	46	17%
releases	427	3%	facilities	445	17%
case	426	3%	energy	71	16%
approach	410	3%	variables	149	15%
quality	395	3%	sample	74	15%
support	371	3%	government	105	15%
value	358	3%	emissions	137	14%
strategy	346	3%	costs	95	13%
sites	319	2%	employees	64	12%
air	310	2%	total	62	12%
areas	310	2%	air	35	11%
responsibility	289	2%	releases	46	11%
survey	273	2%	sites	34	11%
work	269	2%	participation	52	10%
materials	239	2%			

Figure 1:

Concept map of CEP

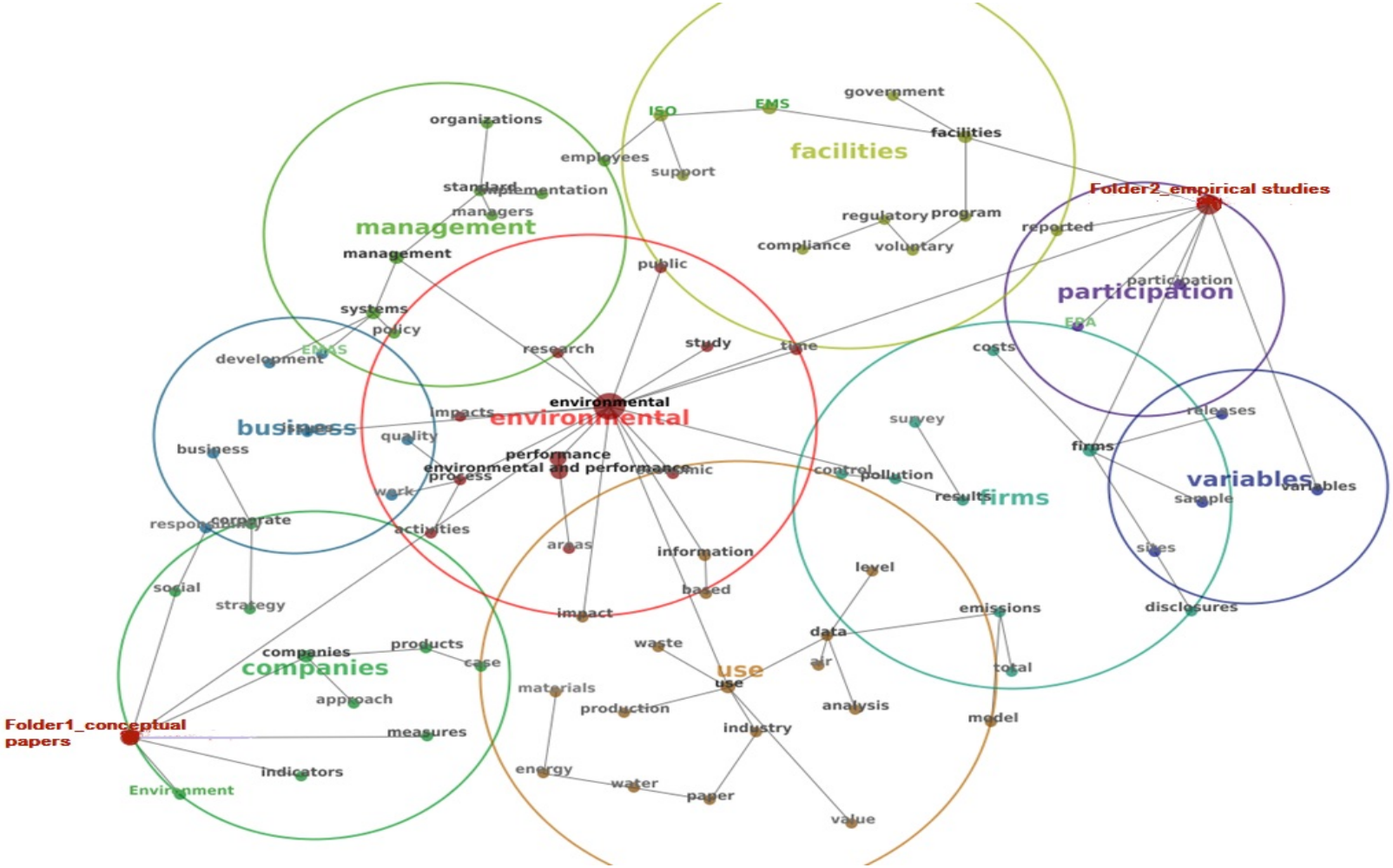
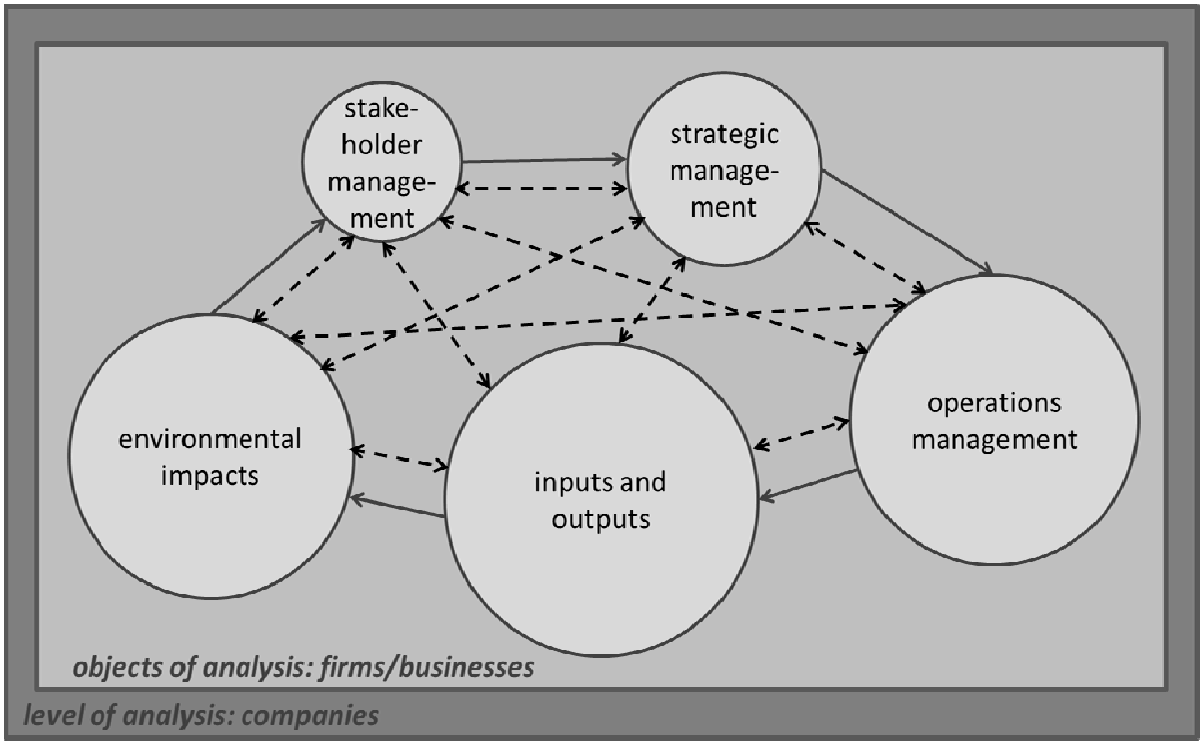


Figure 2:

Parsimonious model of CEP



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